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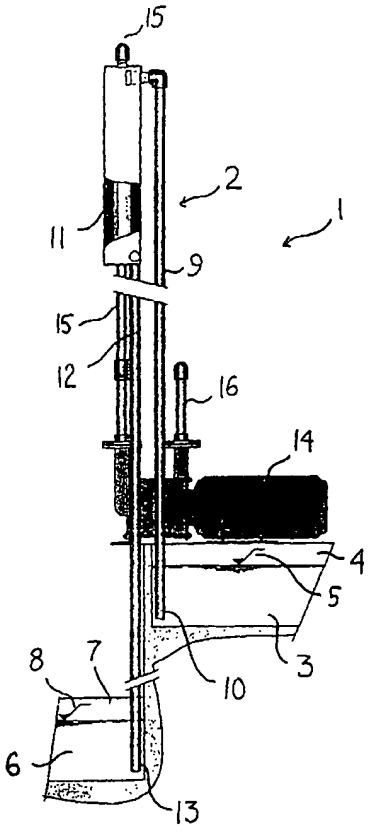
(54) Title: DEVICE FOR TREATMENT AND CLEANSING OF LIQUIDS



(57) Abstract: A device for treatment and cleansing of liquids comprises a first reservoir (4) for inlet liquid (3), and a second, lower reservoir (7) for outlet liquid (6). The reservoirs (4,7) are interconnected by a vertical riser (9) with a liquid inlet (10) in the inlet reservoir (4) and a vertical sink pipe (12) with a liquid outlet (13) in the outlet reservoir (7). A separator (11) is located in an intermediate section between the riser (9) and the sink pipe (12). The inlet liquid (3) is lifted in the separator (11) to a level giving a maximum negative pressure corresponding to 60-80% vacuum. Thus the inlet liquid (3) is strongly supersaturated and gas is stripped as bubbles, forming a floating sludge of particles in the liquid, which is separated in the separator (11). Bacteria in the inlet liquid (3) dies due to acute circuit damages.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

IPC7: C02F 1/04, C02F 1/20, C02F 1/24
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI DATA, EPO-INTERNAL, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2090240 A (PIELKENROOD-VINITEX B.V.), 7 July 1982 (07.07.82), page 2, line 37 - page 3, line 21, figure 1 --	1-9
A	WPI/Derwent's abstract, Accession Number 1978-25982, week 7825, ABSTRACT OF JP, 53018473 (GADERIUSU KK), 20 February 1978 (20.02.78) --	1-9
P,X	CL 00302-2001 A (LUNDE, TRYGVE), 9 November 2001 (09.11.01), the entire document and title page printed from http://www.proind.gov.cl -- --------	1-9

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2090240 A	07/07/82	DE 3150987 A	05/08/82
		FR 2501073 A	10/09/82
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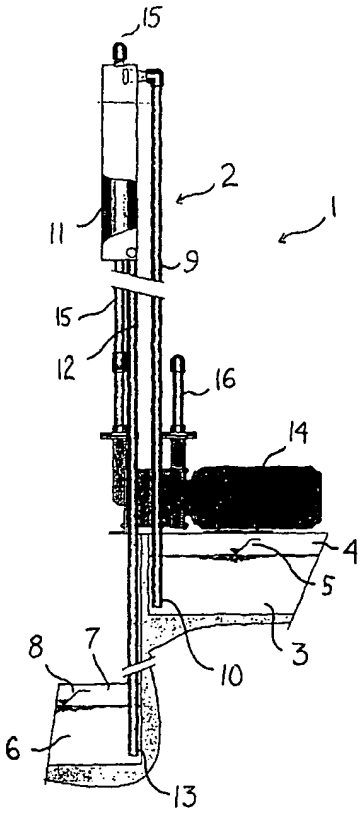

(57) Abstract: A device for treatment and cleansing of liquids comprises a first reservoir (4) for inlet liquid (3), and a second, lower reservoir (7) for outlet liquid (6). The reservoirs (4,7) are interconnected by a vertical riser (9) with a liquid inlet (10) in the inlet reservoir (4) and a vertical sink pipe (12) with a liquid outlet (13) in the outlet reservoir (7). A separator (11) is located in an intermediate section between the riser (9) and the sink pipe (12). The inlet liquid (3) is lifted in the separator (11) to a level giving a maximum negative pressure corresponding to 60-80% vacuum. Thus the inlet liquid (3) is strongly supersaturated and gas is stripped as bubbles, forming a floating sludge of particles in the liquid, which is separated in the separator (11). Bacteria in the inlet liquid (3) dies due to acute circuit damages.

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Device for treatment and cleansing of liquids.

Present invention concerns a device for treatment and cleansing of liquids by a combined gas stripping, particle flotation, and bacteria reduction based upon vacuum technology, according to the introductory part of patent claim 1.

Background

Transport of liquids by means of a siphon is a long standing principle. Liquid from a container is lifted through a closed tube, over a high bend having an outlet in a correspondingly closed different reservoir at a lower level. The lower level reservoir can be a second container, or a free outlet. The driving force giving the liquid transportation is the difference in level between the two liquid surfaces at inlet and outlet, respectively. The difference in level represents a potential energy (quiescent energy), which during operation is transformed into kinetic energy (movement energy) by putting the liquid in movement, and, due to this movement of the liquid, to overcome friction and singular loss by flow through the siphon.

The siphon principle has a major use in a number of applications. As an example, it have been used in water supply from surface water source to waterworks and consumer networks. In order to avoid digging and blasting of deep pipe ditches from the water source, with the danger of simultaneously put the source to comprehensive leakage, the pipe line is formed as a siphon over the water shed between the source and waterworks/distribution system. By this there is no need for installation of water pumps, and external supply of energy.

A method for gas stripping of a liquid by means of a siphon, is know from JP 53018473. On the top of the siphon it is placed a gas/liquid separator, wherein gas dissolved in the liquid will be stripped off due to the vacuum arising by means of the siphon. A device using a siphon for transporting the liquid from one level to another, is known from SU 1268826. On the top of the riser of the siphon, it is placed a separator for stripping the liquid in vacuum. Another device for separating an incoming flow of mixed phase in its components, such as separating a mix phase of solids/liquids/gas, or to non-mixable liquids, is described in Norwegian patent application 19981488, by use of a hydrocyclone.

A problem which may arise in siphon based plants is when the level in the high bend of the siphon is situated so high that the arising negative pressure gives a gas supersaturation in the liquid, and thereby a stripping of gas. This leads to a two-phase flow of liquid and gas, which particularly in high bends can give problems due to separation and accumulation of gas. This may result in blocking of the liquid flow through the high bend and the siphon. Accumulated gas

from the high bend may alternatively get carried away in form of gas slugs (slug flow), which can give damage to installations downstream the high bend.

In the laboratory, gas dissolved in liquids are stripped off by exposing the liquid in a vacuum, so that «boiling» is achieved at the temperature of the liquid.

Particle separation in liquids by means of flotation, uses process and technology in the form of a momentary pressure relief of a gas saturated liquid. The pressurised liquid is mixed with gas which is dissolved in the liquid, and by a momentary pressure relief of the liquid, the gas is released from the supersaturated liquid in the form of gas bubbles. The particle in the water will form a germ for the released gas bubbles, and it arises a separation of air containing sludge, floating to the surface of the liquid. Table 1 below shows different particles and particle dimensions in liquids, and different treatment processes and technology that are used for removing these particles. Flotation is a pure mechanical separation process where the large difference in specific gravity between gas and liquid is used in an intensive separation process.

Table 1: Characteristic particles and separation processes.

Particle characteristics	Suspended, depositable matter					Colloidal, non-depositable matter			Loose, molecular matter	
Particle size [mm]	100	10	1	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}
Treatment process										
Mechanical:	Grid and coarse sieve		Stationary and rotation filter		Microfilter					
	Sedimentation									
			Flotation							
Chemical/mechanical:			Coagulation/ Sedimentation, flotation or filtration							
			Chemical sedimentation, Coagulation/ Sedimentation, flotation or filtration							
Membrane:							Reversed osmosis			

Living organisms exposed to fast and strong pressure relieves, are put to acute circuit damages due to gas bubbles being stripped in the body liquids. The damages on the organisms should be treated with immediate transport to a pressure chamber, where the pressure is lowered gradually, so that the organisms manage to balance the physical changes in the circuit.

Object

It is therefore an object with present invention to provide a combined gas stripping, particle flotation, and bacteria reduction in a vacuum based technology and process, where the vacuum

and the degassing are regulated and handled by means of vacuum pumps that can handle gas, liquid and sludge.

The invention

The object of the invention is achieved by a device having features as stated in the characterising part of patent claim 1. Further features are clear from the belonging dependent claims.

A device according to the invention is suitable for treatment and cleansing of liquids by gas stripping, particle flotation, and bacteria reduction in a technology and process based upon vacuum.

Example of the invention

In the following, the invention will be explained more in details, by means of examples of embodiments and with reference to enclosed drawings, where

Fig. 1 shows a partly sectioned view of a first example of an embodiment of a plant according to present invention,

Fig. 2 shows the embodiment in Fig. 1, viewed from above,

Fig. 3 shows a partly sectioned view of a cyclone separator for separation of gas and floating sludge from a liquid, viewed from one side,

Fig. 4 shows a horizontal section through a gravity separator having lamellas for separation of gas and floating sludge from a liquid, taken along the line IV-IV in Fig. 5,

Fig. 5 shows a vertical section through the gravity separator in Fig. 4, taken along the line V-V,

Fig. 6 shows a partly sectioned view of a second example of an embodiment of a plant according to present invention,

Fig. 7 shows the embodiment in Fig. 6, viewed from above,

Fig. 8 shows a partly sectioned view of a third example of an embodiment of a plant according to present invention,

Fig. 9 shows the embodiment in Fig. 8, viewed along the line IX-IX,

Fig. 10 shows the embodiment in Fig. 9, viewed from above,

Fig. 11 shows a partly sectioned view of a fourth example of an embodiment of a plant according to present invention, viewed from one side, and

Fig. 12 shows the embodiment in Fig. 11, viewed from above,

In Fig. 1 is shown a first embodiment of a plant 1 according to present invention. The plant 1 comprises a siphon 2, which lifts inlet liquid 3 from an inlet reservoir 4 having a liquid level 5, and supplies outlet liquid 6 down into an outlet reservoir 7. A liquid level 8 in the outlet reservoir 7 is lower than the liquid level 5 in the inlet reservoir 4, so that the inlet liquid 3 is transported by gravitation through the siphon 2 down into the outlet reservoir 7.

The siphon 2 comprises a vertical riser 9 having a liquid inlet 10 in the inlet reservoir 4. On the top of the vertical riser 9, inlet liquid 3 is flowing into a separator 11. The outlet from the separator 11 is connected to a sink pipe 12 of the siphon 2. The sink pipe 12 has a liquid outlet 13 in the outlet reservoir 7.

In this example is shown a separator 11, in the shape of a cyclone separator. This can naturally be interchanged by different types of separators, as will be clear from de description below.

In order to start the operation of the siphon 2, a vacuum pump 14 is used, evacuating the gas being within the siphon 2, from the top of the separator 11 through a vacuum pipe 15. At evacuation of the gas, the siphon 2 is filled with liquid 3, 6 from the inlet reservoir 4 and the outlet reservoir 7, respectively. When the siphon 2 is full of liquid 3, 6, the vacuum pump 14 is stopped, and the inlet liquid 3 is flowing by gravitation through the siphon 2 and down into the outlet reservoir 7.

The siphon 2 lifts the inlet liquid 3 to a level above the liquid level 5 in the inlet reservoir 4, so that a maximum negative pressure is achieved, corresponding to 60 - 80 % vacuum. Thus the inlet liquid 3 will be highly gas supersaturated, and gas is released in the form of bubbles. A mixture of gas bubbles and liquid is flowing into the separator 11 where the gas bubbles separates from the liquid. Then the liquid leave the separator 11 in the form of an outlet liquid 6 with low concentration of gas, down through the sink pipe 12 of the siphon 2, and out into the outlet reservoir 7 as a gas subsaturated outlet liquid 6.

A particle rich inlet liquid 3 will, due to the gas release in the siphon 2, result in a bubble formation with particles as bubble germ, and thus a separation of gas and particles in the form of a light float sludge occur in the separator 11. The liquid that is flowing out of the separator 11 and down into the outlet reservoir 7 has gone through a quality change and has become a particle poor and gas subsaturated outlet liquid 6.

A bacterial rich inlet liquid 3 will, due to the pressure sink inside the siphon 2 cause a bacterial death, and the liquid that is flowing out of the separator 11 and down into the outlet reservoir 7 has gone through a quality change and has become a bacterial poor, particle poor and gas subsaturated outlet liquid 6.

Gas and floating sludge that is accumulated in the top of the separator 11, is drained through the vacuum pipe 15 by intermittent operation of the vacuum pump 14. Gas and floating sludge is transported by pressure through the outlet 16 from the vacuum pump 14. The gas, sludge and the outlet liquid may be subjected to different treatments after the outlet of the device according to the present invention, if e.g. they are to be used in other processes.

Fig. 2 shows the plant 1 from Fig. 1 seen from above. The figure shows the inlet reservoir 4 and the outlet reservoir 7, and the siphon 2 connecting the two reservoirs 4, 7 together, through the riser 9, the separator 11 and the sink pipe 12. The vacuum pump 14 evacuates the gas from the siphon 2 at start-up, and arrange for intermittent transport through the vacuum pipe 15 of gas and floating sludge accumulated in the separator 11 during normal operation of the plant 1. Gas and floating sludge are transported under pressure through the outlet 16 from the vacuum pump 14.

Fig. 3 shows the cylindrical cyclone separator 11 of Figure 1, in more detail. The inlet liquid 3 is flowing up the riser 9 and in through a rectangular, tangential inlet 18 of the cyclone separator 11. The cyclone separator 11 is filled with liquid, and gas bubbles / floating sludge 19 is concentrated in the centre of the top of the cyclone separator 11, and is then accumulated in a tank 21 on the top of the cyclone separator 11. The gas bubbles / floating sludge 22 in the tank 21 is drained by intermittent operation of the vacuum pump 14 through the vacuum pipe 15 as a gas/floating sludge outlet 23. Outlet liquid 6 is flowing out of the cyclone separator 11 through the tangential outlet 24 and down into the sink pipe 12.

Fig. 4 shows a horizontal section through a gravitation separator 25 having vertical lamellas 26, as an alternative embodiment of the cyclone separator 11 in Fig. 3. The gravitation separator 25 is a closed container connected to the siphon's riser 9 for inlet liquid 3, distributing the inlet liquid through an inlet manifold 27 in the width of the gravitation separator 25. Correspondingly, the sink pipe 12 of the siphon is connected to an outlet manifold 28 in the width of the gravitation separator 25, for outlet liquid 6. The inlet liquid 3 is distributed in the width of the gravitation separator 25, and flows horizontally through the lamellas package 29, in the shown case comprising twelve parallel, vertical lamellas 26, which are supported in the width by three spacing pipes 30.

At start-up, the siphon 2 and the gravitation separator 25 are filled with liquid 3, 6 by gas being evacuated through the vacuum pipe 15. During normal operation, gas bubbles / floating sludge are accumulated in the top of the separator, and is drained intermittent through the vacuum pipe 15 as a gas/sludge outlet 23.

Fig. 5 shows a vertical section of the gravitation separator 25 in Fig. 4, taken along the line V-V, and shows the location of the inlet manifold 27 in an inlet section 31, and the outlet manifold 28 in an outlet section 32. Orifices 33 in the manifolds 27, 28 are directed against the bottom 34 of the inlet section 31 and the outlet section 32, respectively. In the inlet section 31 over the inlet manifold 27 is located a filter having straight continuous channels 35, in the shown case the channels have hexagonal cross-sections. An equivalent filter with is located over the outlet manifold 28 in the outlet section 32. The filters regulate the turbulence of the liquid flow after passage. The channels of the filter may, of course, have a cross-section of any geometrical shape.

Fig. 6 shows a second example of a plant according to present invention. Contrary to the first embodiment, which is a through flow plant, where the liquid passes once through the plant by gravitation, this second embodiment is a recycling plant 36, where a circulation pump 37 is installed, providing a stable liquid through flow in the recycling plant 36. Provision of untreated inlet liquid 3 is being done in the liquid inlet 10, as a branch pipe directly connected to the riser 9, and the outlet liquid 6 leaves the plant through a level basin 38, having spillway-/level pipe 39 and liquid outlet 13. At provision of a volume of inlet liquid 3, a corresponding volume of outlet liquid 6 will immediately go through the spillway-/level pipe 39 and out in the liquid outlet 13.

The circulation pump 37 will give a constant circulation of liquid with an energy consumption corresponding to friction and singular loss in the riser 9, separator 11, and the sink pipe 12. For starting the operation of the circulation plant 36 is used a vacuum pump 14, evacuating gas through the vacuum pipe 15 from the top of the separator 11. The circulation plant 36 is filled with liquid from the level basin 38. The level from the top of the separator 11 and down to spillway-/level pipe 39 corresponds to a negative pressure at 60-80 % vacuum, and similar processes are being performed as described in connection with the first embodiment, such as gas stripping, particle flotation, and bacteria reduction. Gas and floating sludge accumulated in the top of the separator 11 is drained through the vacuum pipe 15 by intermittent operation of the vacuum pump 14. Gas and floating sludge are transported by pressure through the outlet 16 from the vacuum pump 14.

Fig. 7 shows the circulation plant 36 in Fig. 6 from above, and depicts the inlet 40 and the outlet 41 from the circulation pump 37.

Fig. 8 shows a third embodiment according to present invention, seen from one side; Fig. 9 shows the same seen along the line IX-IX in Fig. 8; and Fig. 10 shows the same seen from above. This is a circulation plant 36, differing from the second embodiment mainly in that all of the circulation plant 36 being located at one level. In order to build up a final negative pressure

corresponding to 60-80 % vacuum, a stepwise build-up of negative pressure is being performed by lifting the liquid in a riser 42, corresponding to available height up to the top of a pressure level reactor 43. The negative pressure established in the riser 42 is maintained, simultaneously that the liquid falls to the bottom of the pressure level reactor 43.

Correspondingly, a further build-up of negative pressure is done in the riser 44 with inlet to level reactor 45, and again in the riser 46 with the following pressure level reactor 47, before the liquid finally is lifted in the riser 48 and into the separator 11.

The levels of the negative pressure is maintained by means of the pressure level reactors 43, 45, and 47, where the liquid falls down to the lowest level. In this third embodiment, the circulation pump 37 must give a constant circulation of liquid with an energy consumption corresponding to friction and singular losses at liquid through-flow in the plant 36. In addition, the circulation pump must add an amount of energy corresponding to the fall in level to the liquid in the pressure level reactors 43, 45, and 47. The operation of the circulation plant corresponds to the plant described in the first and second example, and similar processes are being performed as described in connection with the first example, such as gas stripping, particle flotation, and bacteria reduction.

Fig. 11 shows a fourth example of a plant according to present invention, where the second embodiment of the inventive plant is combined in a corresponding way with the third example of a circulation plant as shown in Fig. 8 - 10.

The fourth example differs from the second and third example by a level basin 38 having spillway/ -level pipe 39 and liquid outlet 13, being integrated in the biological cleansing step 49.

The biological cleansing step 49 comprises an anaerobe submerged biological filter 50 divided in two steps, a first biological step 51 with a downwards liquid flow, a second biological step 52 with a upwards liquid flow, and a through-flow slit 53 in the bottom between first and second biological step 51, 52.

Thereafter, the liquid is flowing further in a pipe 54 to a water distributor 55, which distributes the liquid sectionwise over the quadratic surface 56 of an aerobe biological trickling filter 57. The liquid is rinsed down through a filter medium 58, and then collected in the level basin 38 in the bottom of the trickling filter 57. From the bottom of the level basin 38, liquid flows into a pipe 59, which transfers the liquid to the riser 9, further through the separator 11, the sink pipe 12 an through the inlet 40 to the circulation pump 37. The circulation pump 37 pumps liquid through the pump outlet 41 and up to the biological cleansing step 49.

The liquid flowing in the pump outlet 41 up to the inlet of the anaerobe submerged biological filter 50, is distributed through an inlet manifold 60 in the width of the biological step

51. Correspondingly, the liquid is collected at the outlet of the second biological step 52 in an outlet manifold 61.

Start-up and operation of the plant correspond to what is described in the three first examples, and the processes of gas stripping, particle flotation, and bacteria reduction are being performed as described in connection with these examples. In addition, a biological cleansing of the liquid is achieved through the biological cleansing step 49.

Fig. 12 shows the plant in Fig. 11 seen from above. Supply of untreated inlet liquid 3 is through the liquid inlet 10, which is a branch pipe directly connected to the pipe connection 59 from the outlet of the level basin 38 in Fig. 11, and the riser 13 in Fig. 11. By supply of a volume of inlet liquid 3, a corresponding volume of outlet liquid 6 will immediately be drained.

In the above, it is described that the device is arranged as a flow-through plant, and that the gas and sludge are removed intermittent. With this it is meant that when the device is operating, liquid flows continuous through the plant. The device may, of course, also be operated batchwise , as a given amount of liquid should be treated. Depending on the amount gas and sludge produced during the batch, it may be removed when the batch is done, or during the process.

It will be understood by persons skilled of the art, that the invention is not limited to what is mainly described and shown above. The invention also comprises combinations and sub-combinations of the described features, and modifications and variations of this, within the scope of the following claims, which will be obvious to a person skilled of the art.

Claims

1. Device for treatment and cleansing of liquid by a combined gas stripping, particle flotation, and bacteria reduction based upon vacuum technology, comprising a first reservoir (4) for inlet liquid (3) having a first liquid level (5), a second reservoir (7) for outlet liquid (6) having a second liquid level (8), where the first liquid level (5) is higher than the second liquid level (8), wherein first and second liquid level (4, 7) are connected by at least one substantially vertical riser (9) with a liquid inlet (10) in the first reservoir (4) and at least one substantially vertical sink pipe (12) with a liquid outlet (13) in the outlet reservoir (7),
characterised by a separator (11) being located in an intermediate section between the at least one riser (9) and the at least one sink pipe (12), which separator (11) is located in a height so that the inlet liquid (3) is lifted to a level over the liquid level (5) in the inlet reservoir (4), so that a maximum negative pressure corresponding to 60 - 80 % vacuum, so that the inlet liquid (3) will be strongly supersaturated and gas is stripped in the form of bubbles which together with particles in the liquid forms a floating sludge which is separated in the separator (11), simultaneously as bacteria in the inlet liquid (3) dies due to acute circuit damages as a consequence of gas bubbles being stripped from the body liquids.

2. Device according to Claim 1,
characterised by being constructed as a flow-through plant (1), wherein the riser (risers) (9), the separator (11) and the sink pipe (pipes) (12) form a siphon (2), where the liquid flow is self-driven subsequent to an initial start-up by means of a vacuum pump (14).

3. Device according to Claim 1,
characterised by being constructed as a recycling plant (36), wherein a circulation pump (37) is located for providing a steady liquid through-flow in the recycling plant (36), where supply of untreated inlet liquid (3) is done in the liquid inlet (10) as a branch pipe directly connected to the riser (9), and the outlet liquid (6) leaves the plant through a level basin (38) with a spillway/ -level pipe (39) and a liquid outlet (13).

4. Device according to Claim 1-3,
characterised by the necessary negative pressure corresponding to 60 - 80 % vacuum is established in three consequent steps (42), (44), and (46), before it finally is lifted into the separator (11) in a last step (48), and where the negative pressure level in each step is maintained by means of a pressure level reactor (43), (45), and (47).

5. Device according to Claim 1-4,
characterised by the separator (11) for separation of gas and float mud in the top of the siphon (2), is constructed as a cyclone separator (11) having an accumulator tank (21) on the top of the cyclone separator (11) for collection of gas/floating sludge (22).

6. Device according to Claim 1-4,
characterised by the separator (11) in the top of the siphon (2) is constructed as a gravitation separator (11) having vertical lamellas (26), with an inlet section where an inlet manifold (27) distributes the liquid through a filter having straight continuous channels (35), and with an outlet section (32) located for extracting liquid evenly out through a corresponding filter with channels (35) and out through an outlet manifold (28), wherein gas/ floating sludge is accumulated in the uppermost part of the gravitation separator (25).

7. Device according to Claim 1-4,
characterised by the separator (11) for separation of gas and floating sludge in the top of the siphon (2), is constructed with a vacuum pipe (15) for draining of gas/ floating sludge (22) in the top of the separator (11) by intermittent operation of a vacuum pump (14).

8. Device according to Claim 1-7,
characterised by further comprising an integrated biological step (49), where the level basin (38) with spillway/ -level pipe (39) and liquid outlet (13), are integrated in the biological cleansing step (49).

9. Device according to Claim 8,
characterised by the integrated biological cleansing step (49) comprises an anaerobe submerged biological filter (50), and an aerobe biological trickling filter (57) where the liquid is distributed sectionwise over the quadratic surface (56) through a water distributor (55).

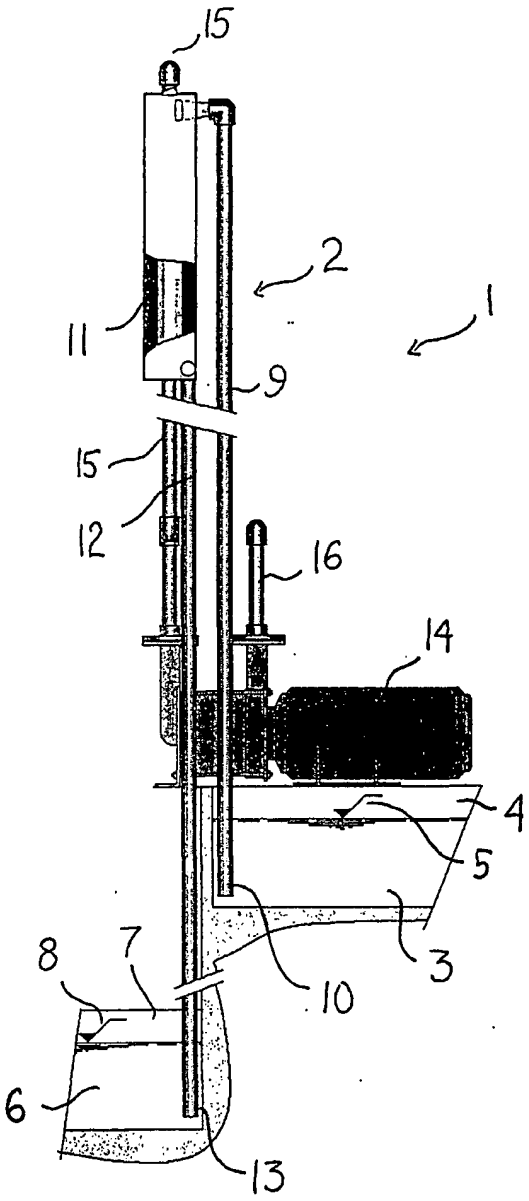

Fig.1

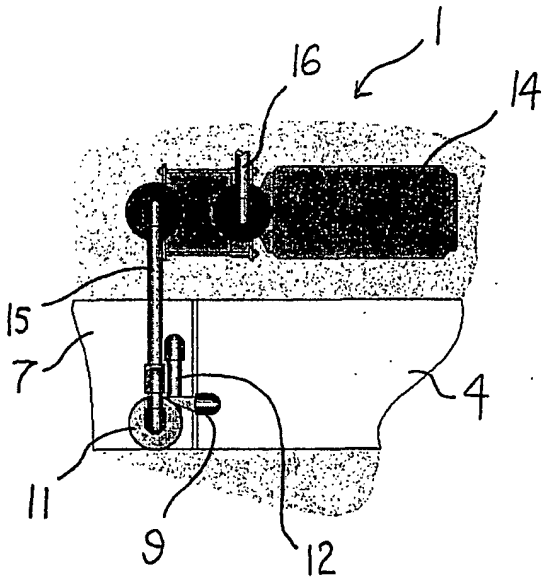

Fig.2

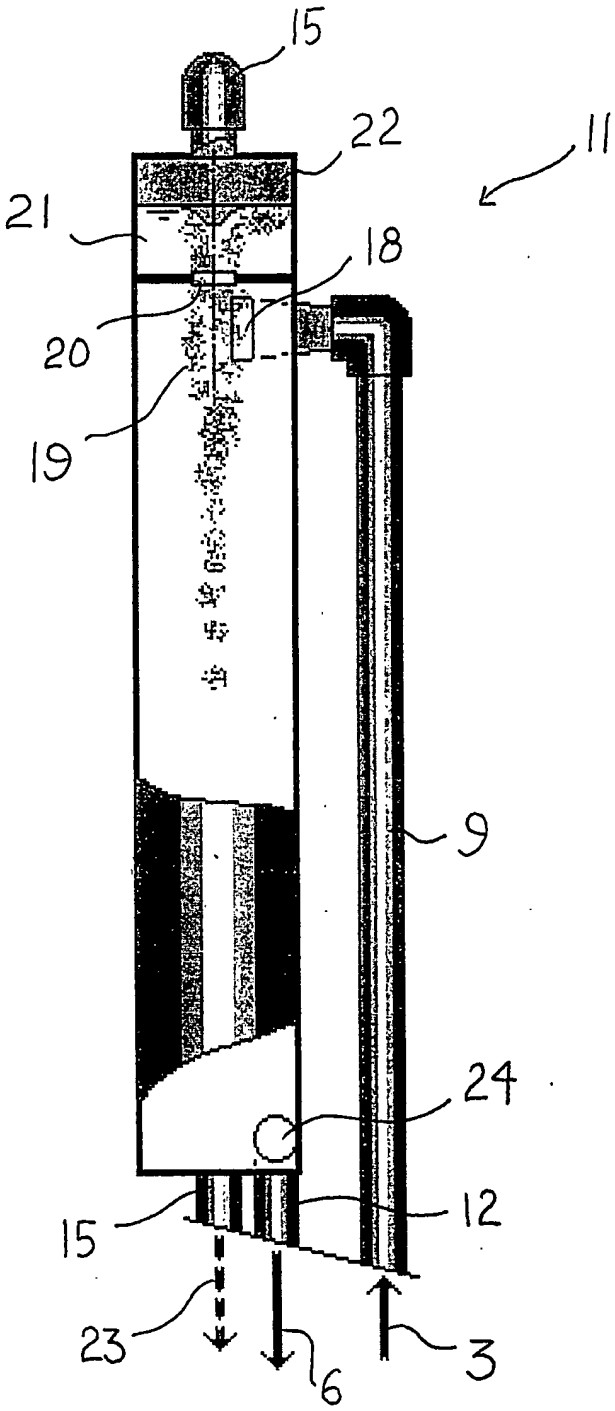

Fig.3

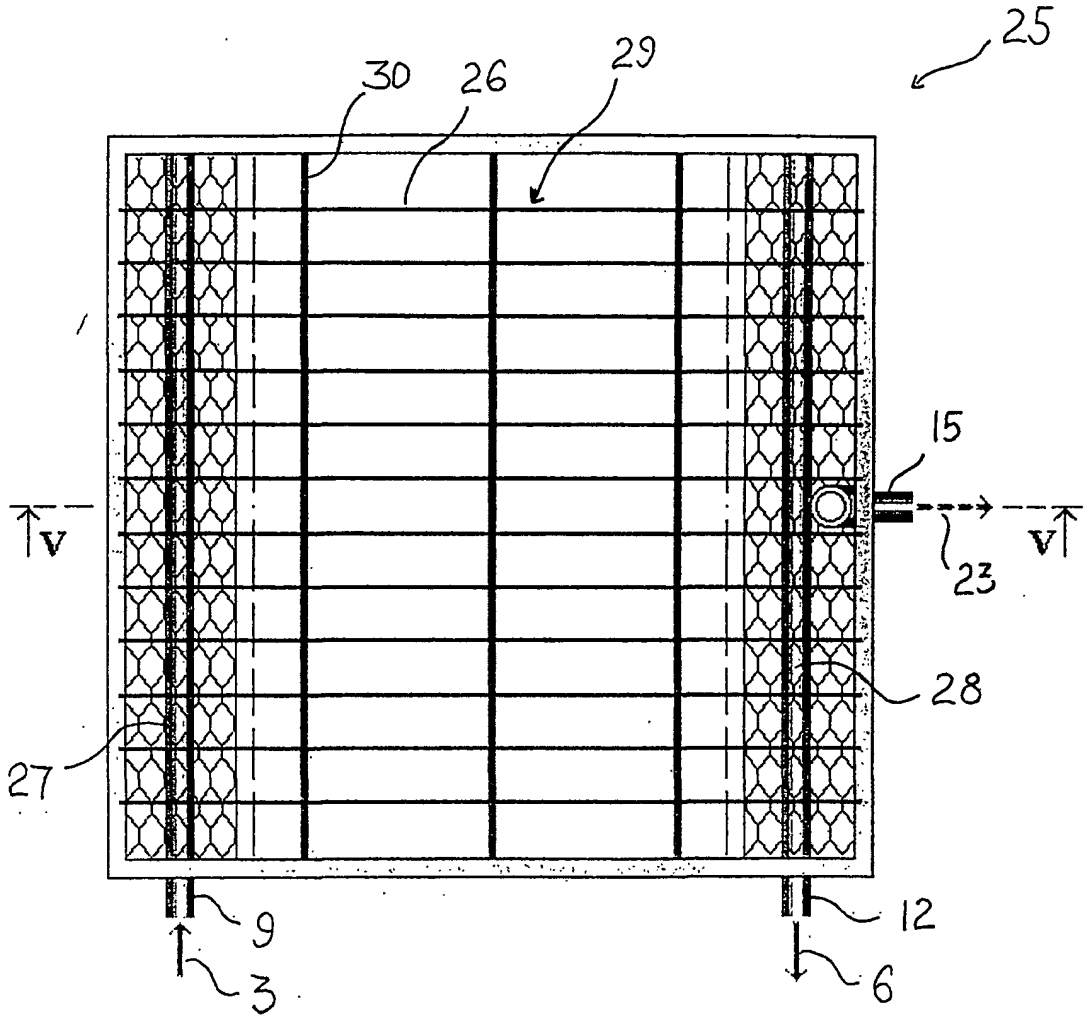
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Fig.4

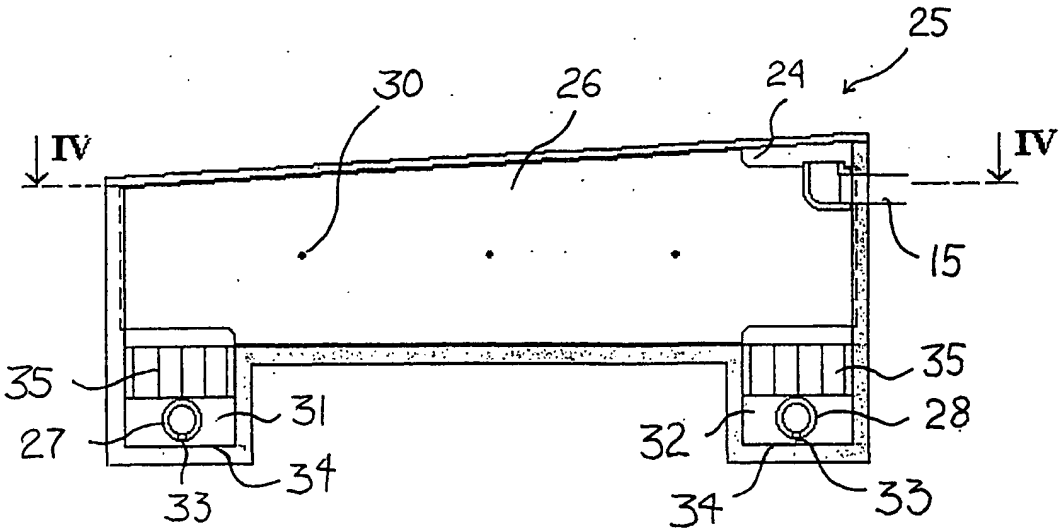
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Fig.5

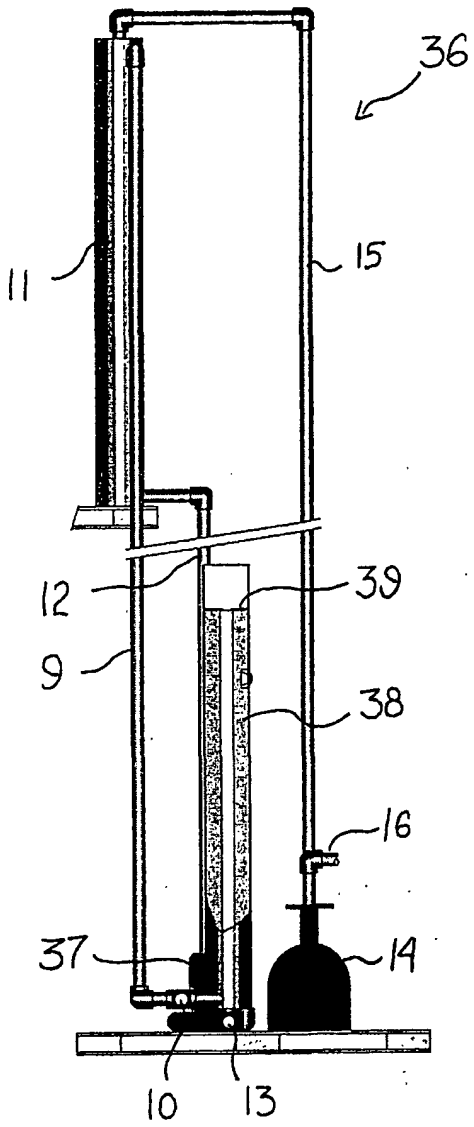

Fig.6

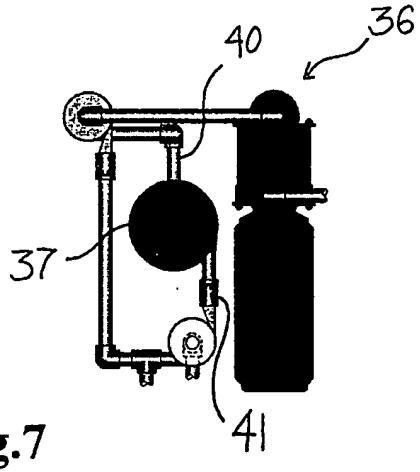

Fig.7

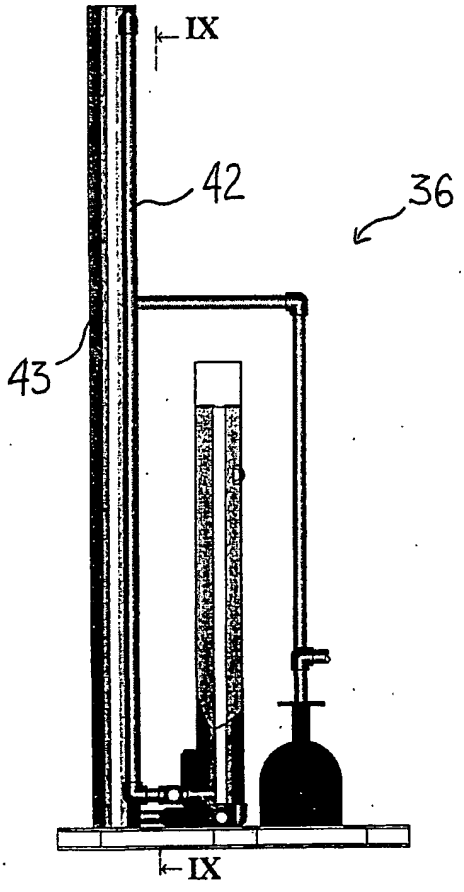

Fig.8

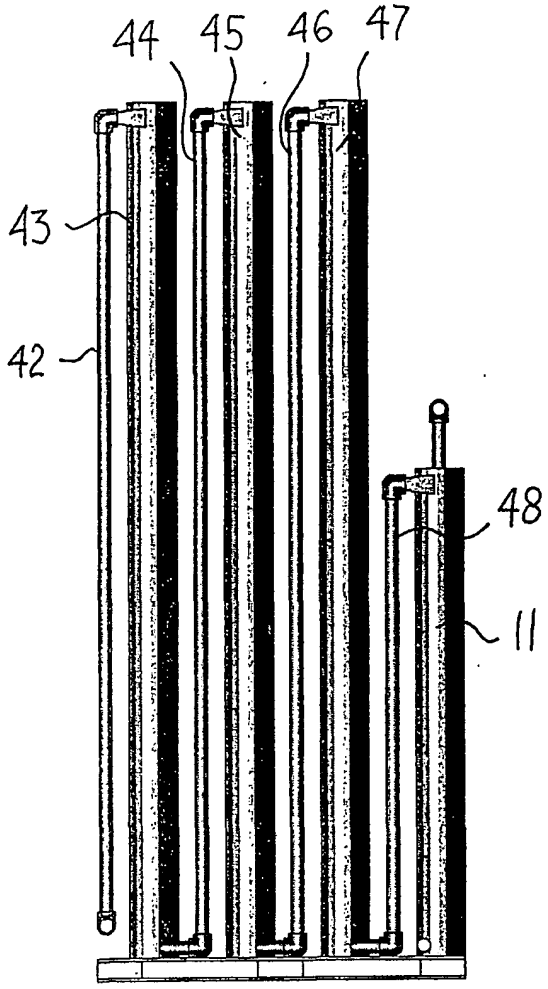

Fig.9

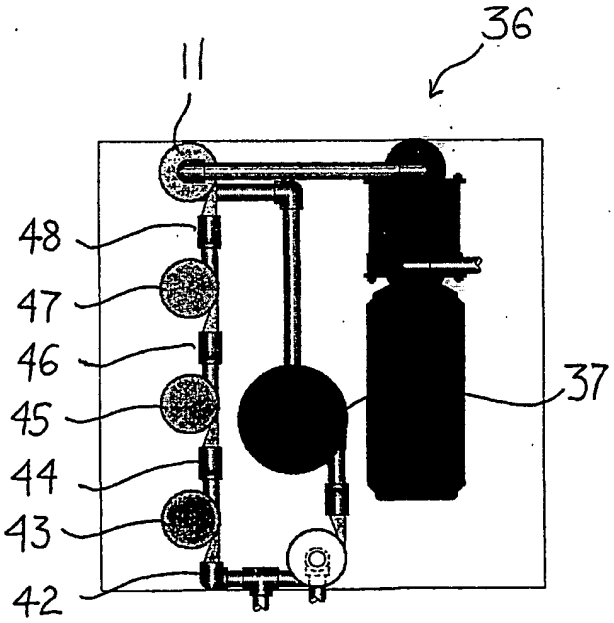

Fig.10

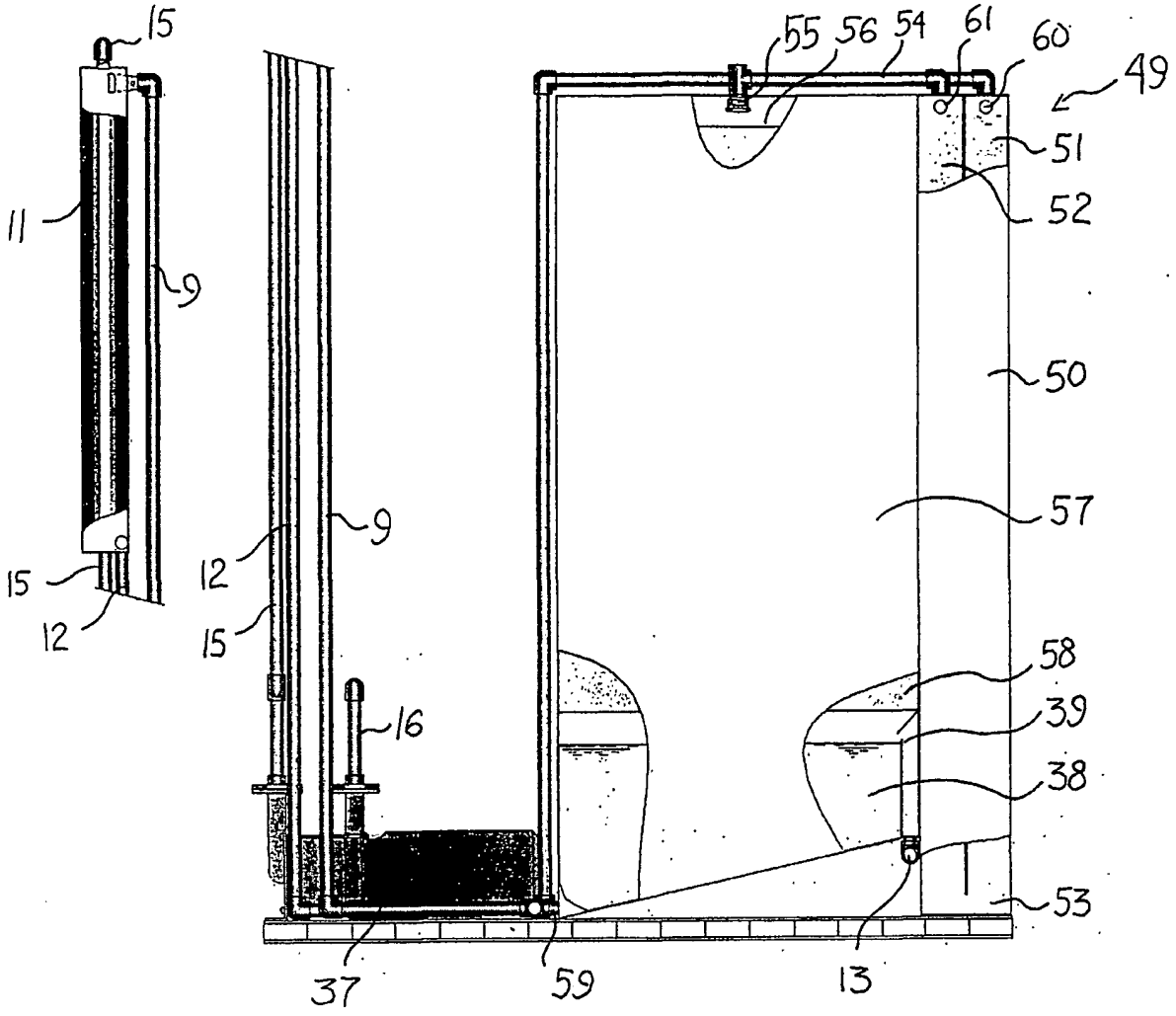
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Fig.11

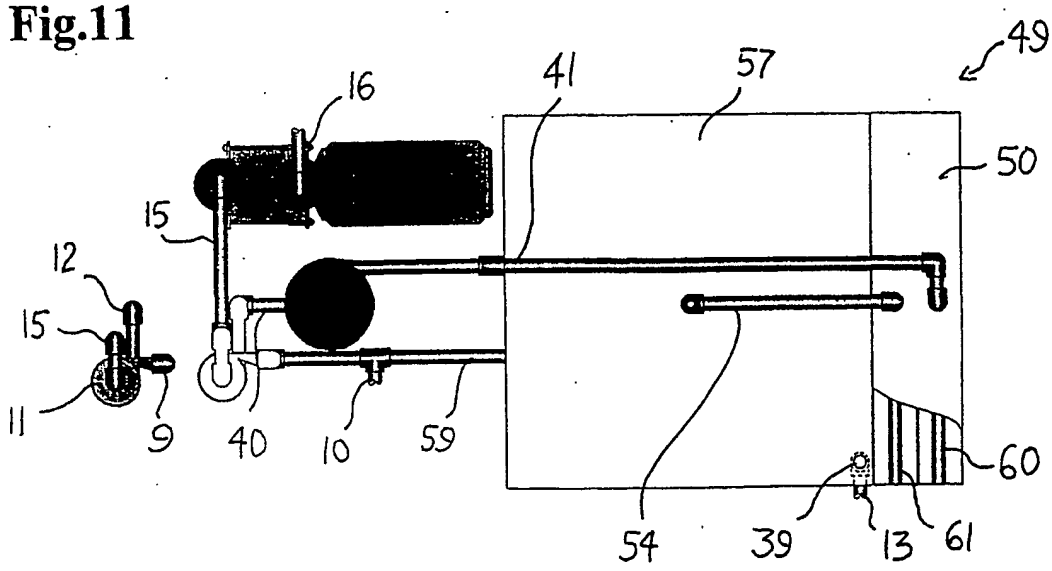
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Fig.12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 02/00046

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: C02F 1/04, C02F 1/20, C02F 1/24
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: C02F, B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI DATA, EPO-INTERNAL, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2090240 A (PIELKENROOD-VINITEX B.V.), 7 July 1982 (07.07.82), page 2, line 37 - page 3, line 21, figure 1	1-9
A	WPI/Derwent's abstract, Accession Number 1978-25982, week 7825, ABSTRACT OF JP, 53018473 (GADERIUSU KK), 20 February 1978 (20.02.78)	1-9

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 June 2002	25 -06- 2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Jens Waltin/ELY Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/05/02

International application No.
PCT/NO 02/00046

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2090240 A	07/07/82	DE 3150987 A	05/08/82
		FR 2501073 A	10/09/82
		NL 8007096 A	16/07/82